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Short communication

A comparison of total pollen counts obtained 5.6 km apart

David A. Frenz [a,*], Sonya E. Melcher [a], Laura W. Murray [a], Richard E. Sand [b]

[a] *Multidata Inc., 10801 Wayzata Boulevard, Suite 330, Minnetonka, MN 55305, USA*
[b] *St. Paul Allergy and Asthma Clinic, 565 Snelling Avenue South, St. Paul, MN 55116, USA*

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Abstract

Total pollen counts obtained from a single pollen-sampling device are often broadcasted by the news media to assist allergy sufferers. In releasing these data, it is assumed that counts obtained in a single location represent pollen conditions throughout a large city. Volumetric pollen data collected at two locations in St. Paul, Minnesota, were used to test the suitability of this practice. A total of 122 pollen counts performed between April and October 1993 at each location were compared. Although the total number of pollen grains recovered during the study period by the two samplers was nearly equivalent, some monthly and daily differences were uncovered. Differences between the locations grew as pollen counts increased and were most pronounced for counts exceeding 100 pollen grains/m^3. Despite the differences between the locations, this study demonstrated that pollen counts obtained with a single pollen-sampling device may be cautiously used to represent pollen conditions in a large community.
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1. Introduction

Many physicians in the United States provide pollen counts to the news media to assist individuals affected by allergies (Giberson et al., 1997). In releasing these data to the public, three simplifications generally occur.

First, pollen counts are frequently reduced to a single number—typically the total number of pollen grains per cubic meter of air. Although these total expressions lack the utility of counts detailed by pollen type, it is assumed they indicate the potential pollen challenge to humans.

Second, pollen counts are frequently transformed from numeric data to low, moderate, high and very high descriptors (Burge, 1992). The authors have released information of this type, generally as total pollen counts with associated descriptors, to the media and the public in St. Paul, Minnesota, for the past decade.

Third, pollen counts broadcasted by the media are generally collected with a single pollen-sampling device. In releasing these data to the public, it is assumed that pollen counts obtained in one location represent pollen conditions throughout a large city. Although this assumption appears reasonable, it has not been tested in St. Paul.

The purpose of this present investigation was to compare total pollen counts collected at two locations in St. Paul under standardized conditions. The resulting data were used to explore the suitability of releasing total pollen counts from one pollen sampler to the media and the public.

* Corresponding author. Tel.: +1 612 5441499; fax: +1 612 5441977; e-mail: dfrenz@pollen.com

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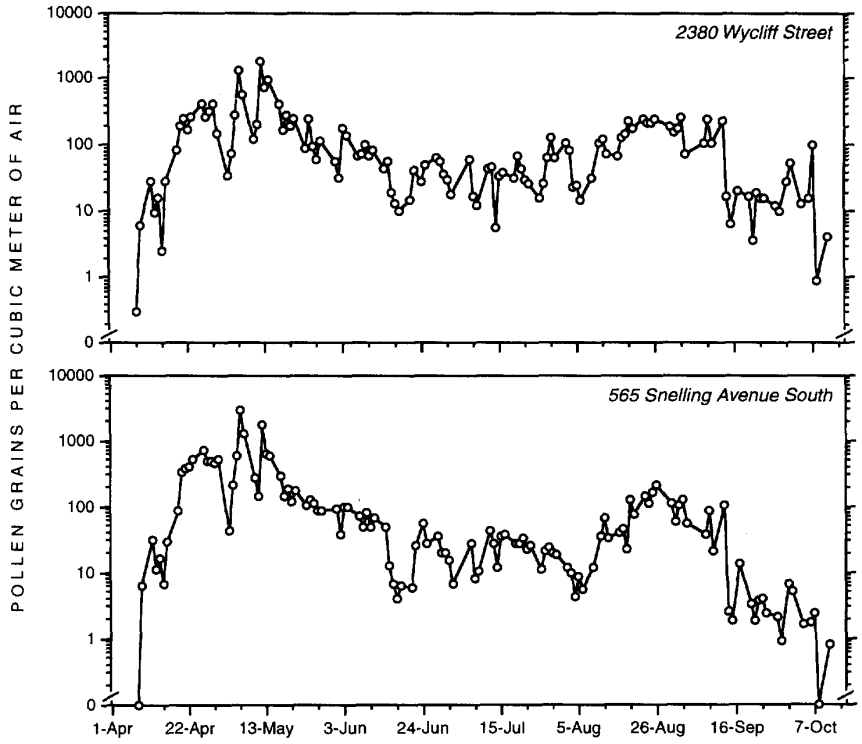

Fig. 1. Pollen recovery at each St. Paul, Minnesota location during the 1993 pollen season.

2. Materials and methods

During the spring of 1993, Rotorod Samplers (Sampling Technologies, Minnetonka, MN) were installed on the roof-tops of two buildings in St. Paul. The first building, a two-story office complex, was located in an industrial park in northwest St. Paul. Commercial and industrial properties surrounded the building in all directions with rail yards to the north and east.

The second building, a one-story allergy clinic, was located in southwest St. Paul. The areas surrounding the building were largely residential. The distance between this building (565 Snelling Avenue South) and the first building (2380 Wycliff Street) was ≈ 5.6 km by air.

Pollen counts were performed in the standard manner (Brown et al., 1993). Briefly, both Rotorod Samplers were programmed for a 10% duty cycle. One investigator (DF) coated the collector rods with silicone grease (General Electric G-697; General Electric, Waterford, NY) and changed the retracting heads at approximately noon, Monday through Friday. After collector rods were removed from the retracting heads, another investigator stained the rods with Calberla's solution (Gay et al., 1941) and analyzed them at 200 × with a light microscope (Cenco 60913-44; Central Scientific, Franklin Park, IL). The atmospheric pollen concentration (pollen grains/m^3) was calculated from the number of grains tallied on each rod (Frenz et al., 1996).

The second author (SM) analyzed all the samples collected between 8 April and 16 August ($n = 176$), while the third author (LM) processed the rods obtained from 17 August through 11 October ($n = 68$).

Pearson's correlation was computed for the pollen counts obtained with the Rotorod Samplers. Differences between the two locations were assessed using a parametric analysis of variance (ANOVA).

3. Results

A total of 122 atmospheric pollen samples were collected at each location between 8 April and 11 October 1993 (Fig. 1). Of these, 97 samples represented 24-h collection periods, while the remaining 25 samples were collected over periods several days long (e.g. weekends).

Counts were found to be correlated using Pearson's correlation coefficient ($R = 0.864$). A parametric analysis of variance indicated that differences in pollen recovery between the two locations were not statistically significant ($P = 0.974$).

Table 1
Pollen recovery (pollen grains/m^3 of air) by month at each St. Paul, Minnesota location during the 1993 pollen season

Month	Wycliff	Snelling
April	2659	4431
May	8159	9717
June	1266	891
July	827	445
August	2682	1275
September	1405	570
October	190	12

3.1. Seasonal and monthly differences

The total number of pollen grains recovered during the study period by the two Rotorods was nearly equivalent, however, monthly differences existed (Table 1). Less pollen was recovered during April and May at the Wycliff location compared to the Snelling location. In contrast, the Rotorod at the former site recovered more pollen during the period of June through October.

3.2. Daily differences

The absolute mean difference between pollen counts collected at the two locations was 76.4 pollen grains/m^3/sample. In contrast, the absolute median difference was 26.7 pollen grains/m^3/sample.

A variation of < 10 pollen grains/m^3 was recorded in 33 samples (27%), while 30 samples (25%) varied by > 100 pollen grains/m^3. The most extreme case, the samples collected on 6 May, differed by 1562 pollen grains/m^3.

In general, differences in pollen counts collected at the two locations became larger as pollen counts increased (Table 2). On average, pollen counts varied by < 11 pollen grains/m^3 when the atmospheric pollen concentration at the Wycliff site was 50 pollen grains/m^3 or less. Differences became more pronounced for pollen counts between 50 and 500 pollen grains/m^3 and large differences were noted when pollen counts exceeded 500 pollen grains/m^3.

Table 2
Pollen recovery (pollen grains/m^3 of air) in seven ranges at the Wycliff location and the difference (absolute value) between corresponding pollen counts collected at the Snelling location during the 1993 pollen season

Wycliff location		Wycliff–Snelling locations		
Pollen count	Samples	Range	Mean ± S.D.	Median
<10	10	0.0–9.1	3.1 ± 2.9	2.6
10–25	20	0.3–19.4	10.5 ± 4.7	11.1
25–50	21	0.1–25.5	10.3 ± 8.2	8.0
50–100	23	2.7–135.9	35.8 ± 27.3	32.6
100–200	23	25.5–377.6	102.3 ± 72.1	88.7
200–500	20	31.1–306.4	138.0 ± 75.4	127.3
>500	5	111.4–1561.5	585.4 ± 595.1	427.6

4. Discussion

This study explored the common practice in the United States of releasing total pollen counts from a single pollen-sampling device to the media and the public. On the basis of the data obtained in St. Paul, three important findings emerged.

4.1. The 1993 pollen season

Pollen counts obtained with the two devices were correlated, indicating the pollen season developed in a similar manner at both locations. Although samples collected at each location differed numerically, the atmospheric pollen concentration in both parts of the city increased and decreased in concert. This suggested that the timing of flowering events as well as the environmental pressures on pollen shed were similar in both neighborhoods in St. Paul.

4.2. Seasonal and monthly differences

On an aggregate basis, pollen shed at the two locations in St. Paul appeared to be nearly equivalent. An analysis of monthly pollen recovery, however, suggested this aggregate result may have been fortuitous. Higher pollen counts obtained during the spring at the Snelling location were offset by lower pollen counts during the summer and fall.

Differences between pollen counts appeared to reflect underlying differences in the flora of the respective neighborhoods. Higher pollen counts in the spring at the Snelling location was consistent with the tree-lined streets found in that largely residential neighborhood. In contrast, higher pollen counts in the summer and fall at the industrial Wycliff site likely resulted from grasses and weeds which grew uncontrolled in the rail yards.

4.3. Daily differences

A comparison of samples obtained during the seven-month study period indicated that pollen counts at the two locations were frequently similar. As demonstrated by the median statistic, half of the pollen counts varied by < 27 pollen grains/m^3. Furthermore, of this left tail, approximately half of the samples varied by < 10 pollen grains/m^3. It is thought that data obtained with either pollen-sampling device during these sampling periods could be used to represent the general pollen conditions in St. Paul.

In contrast, pollen counts at the two locations often varied by large margins. As demonstrated by the mean statistic, the distribution of the differences in pollen counts was skewed toward extreme values in the right tail. Of the data above the median, approximately half of the samples differed by > 100 pollen grains/m^3.

As indicated by Table 2, these large differences began to occur when pollen counts exceeded 50 pollen grains/m^3 and were most frequently observed for pollen counts exceeding 100 pollen grains/m^3. In Burge's system (Burge, 1992), pollen counts > 90 pollen grains/m^3 are classified as 'high' for tree, grass and weed pollen. Therefore, these wide numerical differences would generally not lead to different characterizations of pollen conditions, regardless of the season.

Neither this study nor Burge's system, however, addressed how allergy symptoms change with pollen conditions. Both approaches characterized pollen counts on a mathematical basis which may not correlate with allergic symptomology. Previous investigations demonstrated that dose-response curves generally have steep slopes and that symptom scores often reach a maximum at relatively low atmospheric pollen concentrations (Viander and Koivikko, 1978; Wilkinson and Taudorf, 1984; Bronström and Möller, 1989). This suggests that the large differences we uncovered for 'high' pollen counts may be less important in terms of symptomology than apparently small differences between 'low' or 'moderate' pollen counts.

In the absence of more compelling clinical data, however, this present investigation demonstrated that total pollen counts obtained with a single pollen-sampling device may be cautiously used to represent pollen conditions in a large community. The authors encourage similar investigations in other cities where pollen counts obtained with a single pollen-sampling device are broadly distributed to the media and the public.

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